SolarPACES 2012
Concentrating Solar Power and Chemical Energy Systems
September 11 – 14, 2012 · Marrakech, Morocco

BETTER: EU-North Africa Case Study
The Role of Concentrating Solar Power

Tobias Fichter*, Franz Trieb*, Natalia Caldes**

*DLR-Institute of Technical Thermodynamics, Stuttgart, Germany
**CIEMAT, Madrid, Spain

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BETTER: "Bringing Europe and Third countries closer Together through renewable EneRgies"

(July 2012 - January 2015)

Objective:

Assess, through case studies, stakeholders involvement and integrated analysis to what extent cooperation with third countries (Art. 9 of the RES Directive) can help Europe achieve its RES targets in 2020 and beyond, through RES imports and by triggering the deployment of RES electricity projects in North Africa, Balkans and Turkey.

Supported by INTELLIGENT ENERGY EUROPE

PARTNERS:

CIEMAT, DLR, ECN, JR,
TU-WIEN, OME, NTUA,
UNDP, PIK

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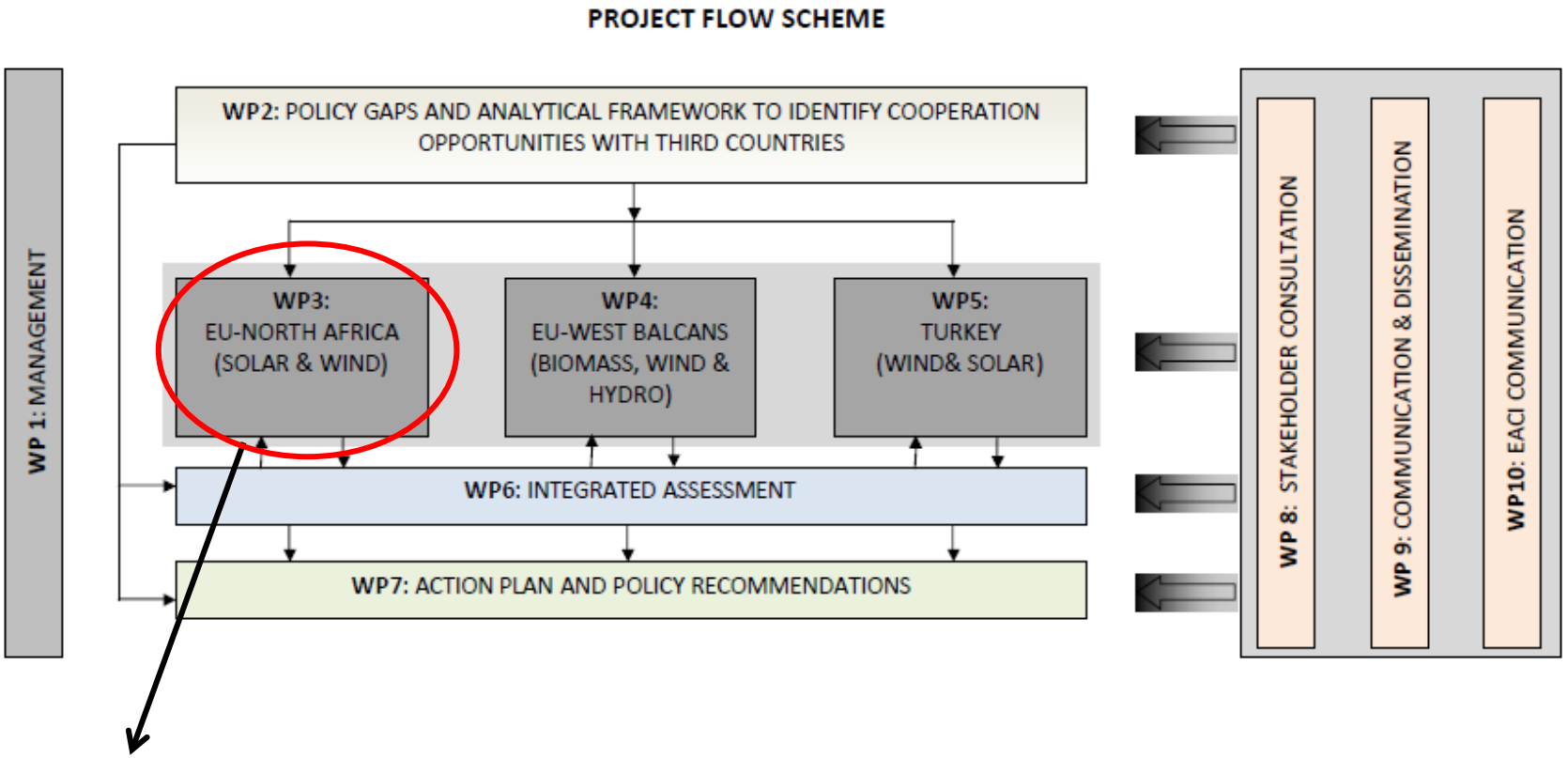
BETTER – Project overview



3.2: Prospects for RES-E expansion in North Africa

3.3: Prospects for RES-E exports from North Africa to Europe

Expected Results

1) Evaluation through **case studies and integrated analysis** of the impacts associated to the implementation of the cooperation mechanisms.

2) **Action plan to foster RES energy** production, transfer and use in the EU and third countries through cooperation mechanisms.

3) **Policy recommendations.**

4) Set of **practical guidelines** in order to foster and promote the active involvement of private sector in the deployment of mutually beneficial RES-E projects using the cooperation mechanism.

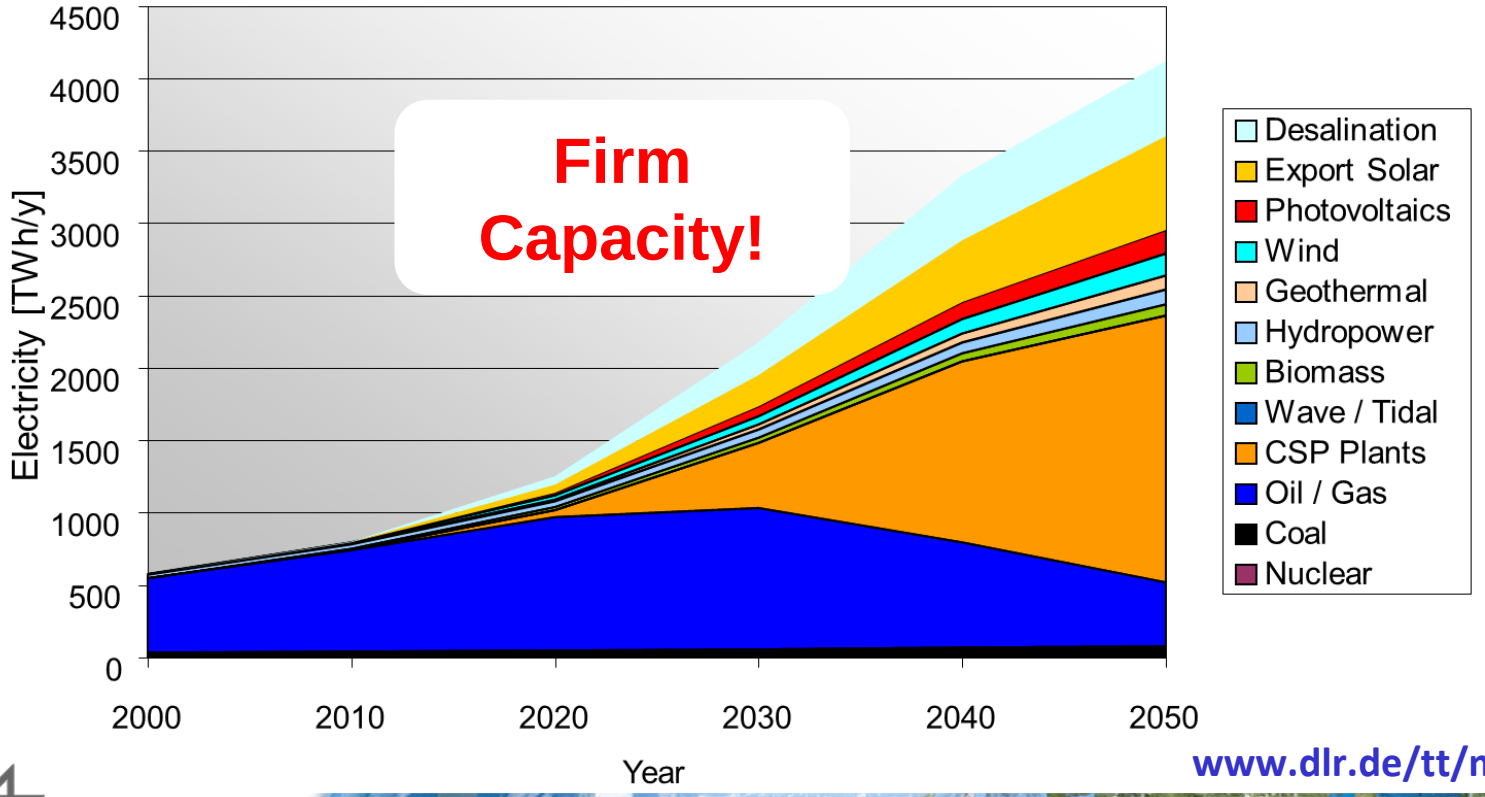
5) Establishment of a solid and productive **stakeholder network between EU and 3rd countries** as well as relevant existing initiatives to foster RES cooperation and knowledge transfer.

6) Generation of knowledge and **dissemination material** to advocate in favour of EU cooperation mechanisms as well as RES deployment.

WP 3.2.: Prospects for RES-E expansion in NA

Background

MED-CSP Study 2005:
Electricity supply in the Middle East & North Africa

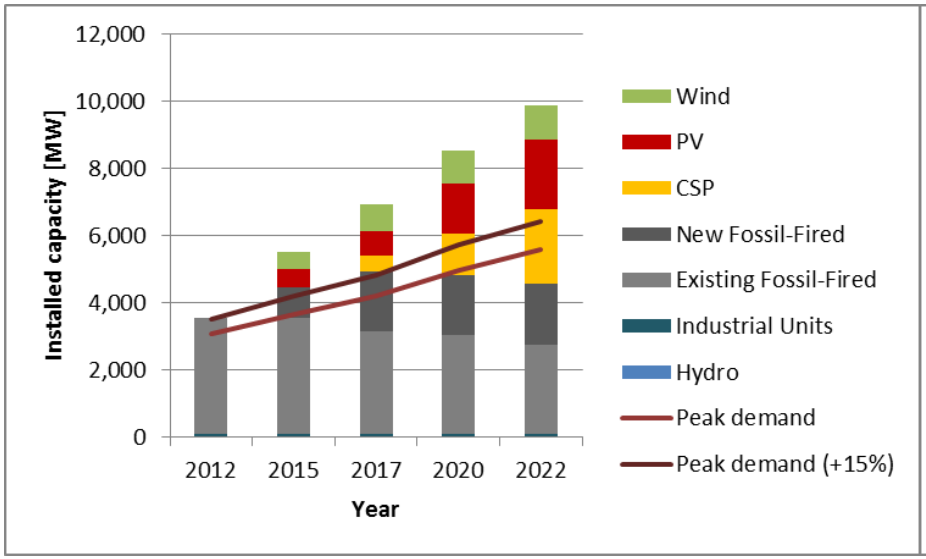


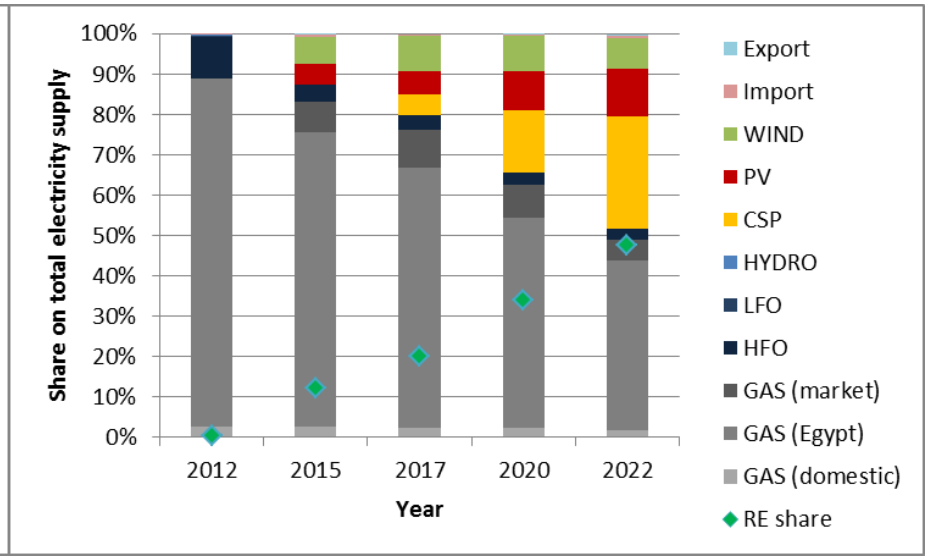
www.dlr.de/tt/med-csp

WP 3.2: Prospects for RES-E expansion in North Africa

ReMix-MENA cost optimization model for capacity expansion

- Example: Case study for Jordan
- Jordan's situation:
  - Strongly increasing electricity demand
  - High dependency on fossil fuel imports
  - Peak- and upper mid-merit load by expensive H.F.O. and L.F.O.





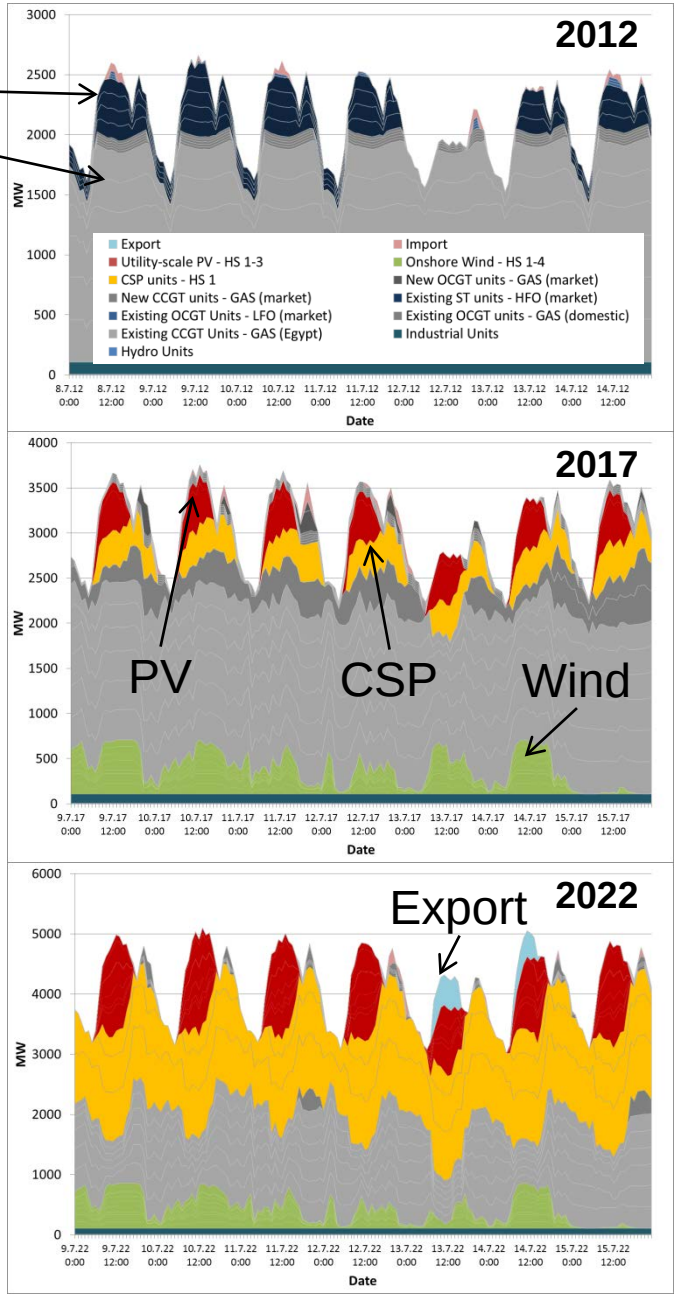
Scenario: „base case"

Source: Fichter (DLR) 2012, ReMix-MENA optimization tool

Business case NA

Strongly required firm and flexible renewable power capacity

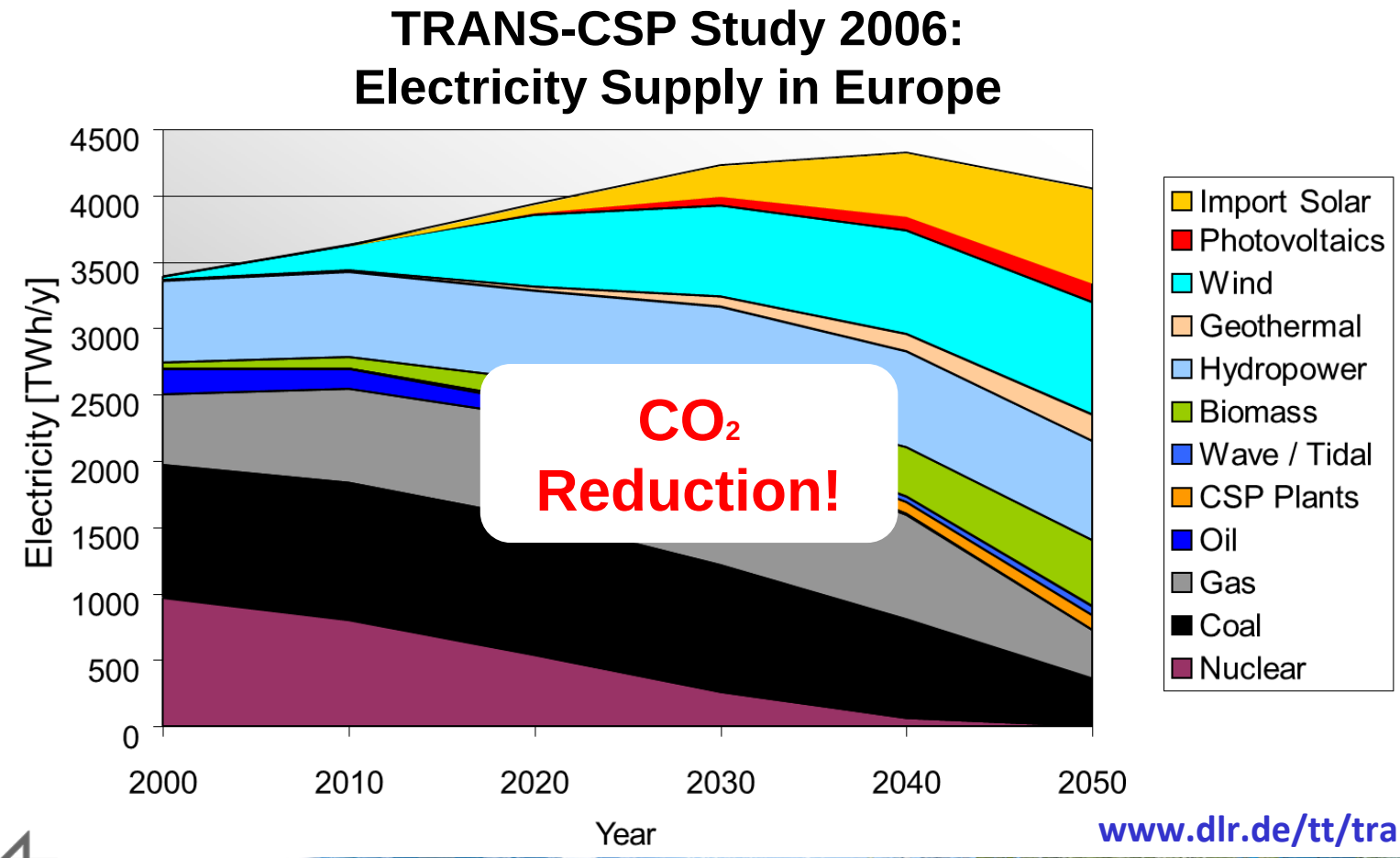
- CSP competitive in the peak and upper-mid merit segment in the short-term.
- CSP providing strongly required firm and flexible power capacity.
- Very limited availability of electricity storage and of other flexible and firm RES-E.
- PV and wind power as cheap “fuel saver”
- In the medium-term CSP competitive in mid-merit and base load segment.
- CSP in long-term as back-bone of electricity supply.



Source: Fichter (DLR) 2012, ReMix-MENA optimization tool

WP 3.3.: Prospects for RES-E exports from NA to Europe

Background:



www.dlr.de/tt/trans-csp

WP 3.3: Prospects for RES-E exports from NA to Europe

Why CSP imports from North Africa and not from Southern Europe?
Higher CSP availability in MENA → flexible renewable power

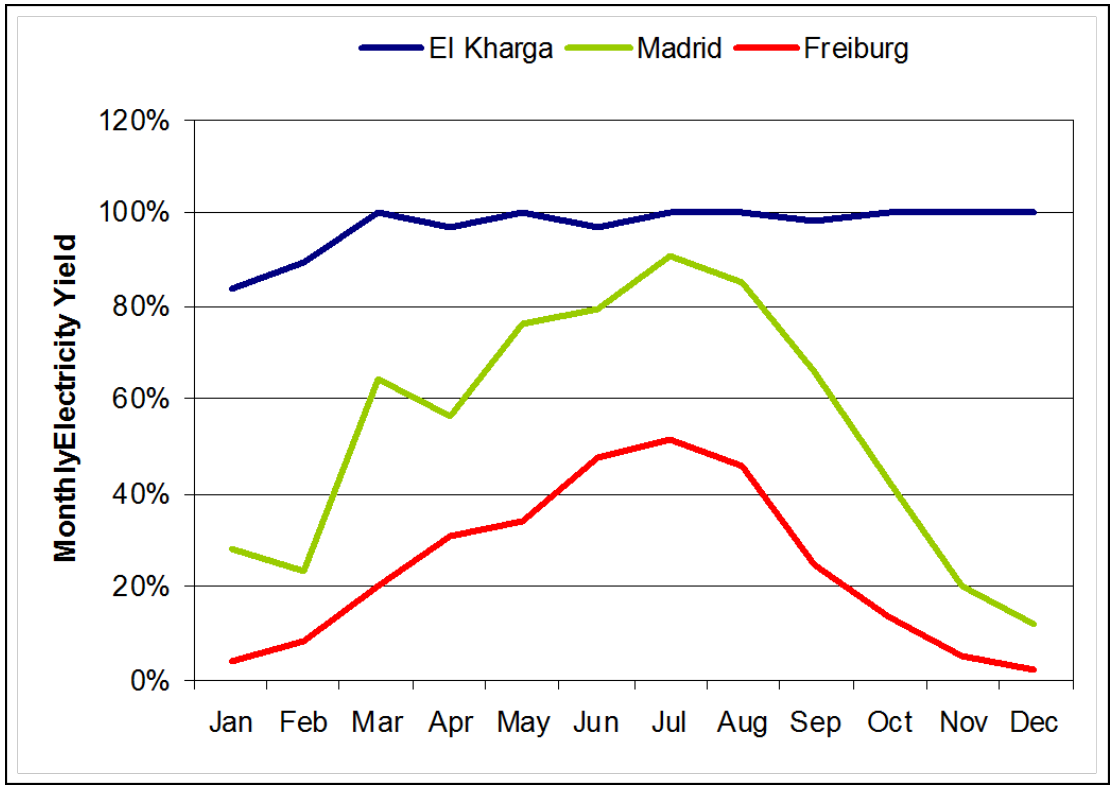
Comparison:

CSP with Solar Multiple 4 at different sites

MENA:

- More sunny days
- Lower Latitude

➔lower seasonal variation of electricity yield



Business case EU

Flexible renewable power

Case study Germany 2050

The role of variable and flexible renewable power sources in a 90% renewable electricity scenario for the year 2050 for Germany.

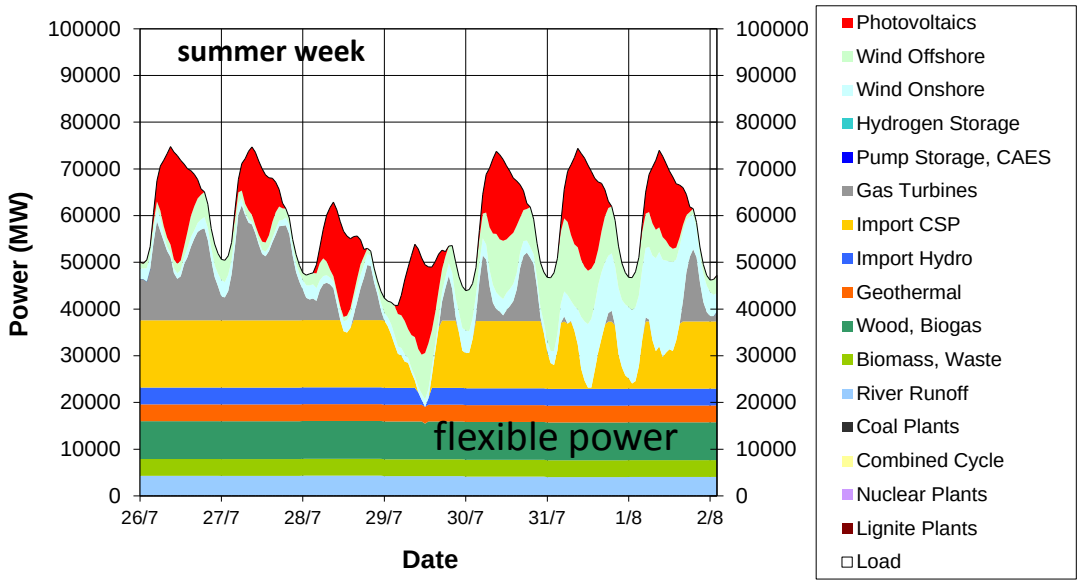
Installed Capacities:

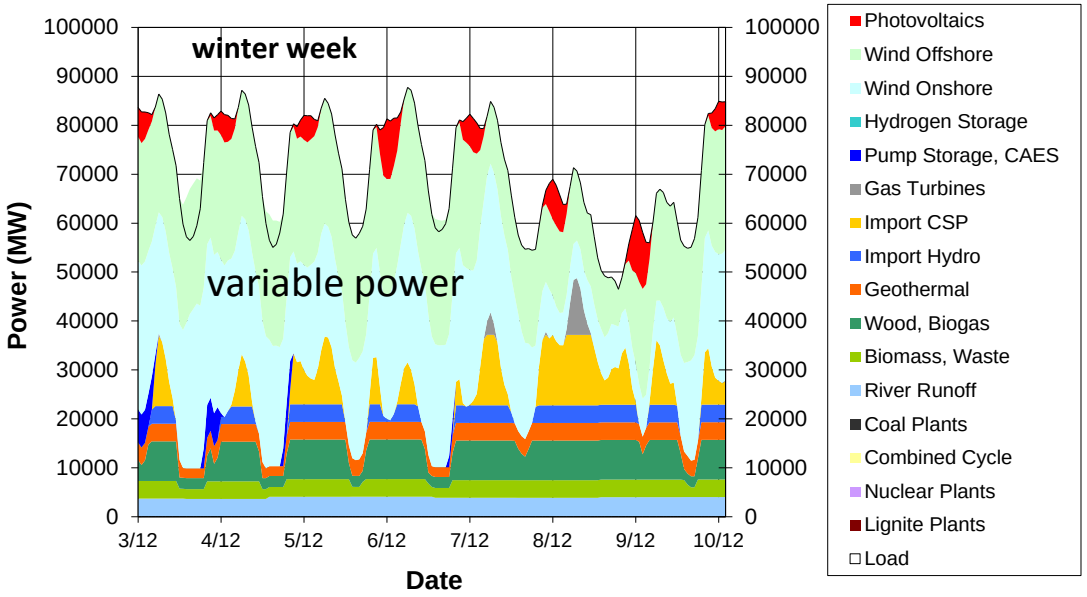
Photovoltaics:	45 GW
Wind Onshore:	40 GW
Wind Offshore:	27 GW
Runoff Hydropower:	6 GW
Import CSP:	16 GW
Import Hydro:	4 GW
Geothermal:	4 GW
Biomass:	9 GW
Biomass Waste:	4 GW
Natural Gas:	63 GW

50% var. RE

40% flex. RE

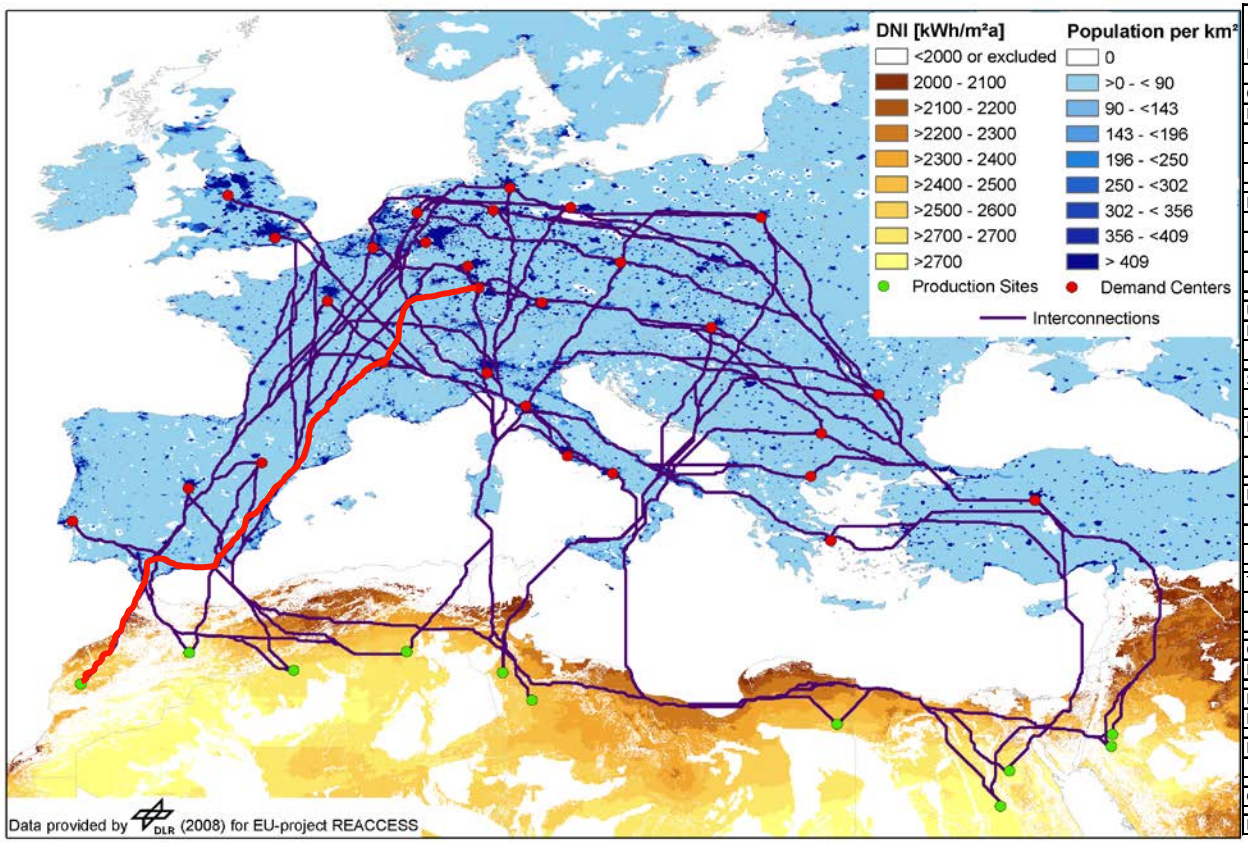
10% flex. Fuel





Business case EU

The TRANS-CSP / DESERTEC Concept – flexible solar power plus 33 additional energy corridors with firm capacity for Europe in 2050



Import Country	Start Point	End Point	Net Import Electricity	Total Length
			TWh/a	km
Germany / Denmark	Morocco #1	Karlsruhe, Germany	23,0	2.917
	Morocco #2	Jülich, Germany	24,5	2.455
	Tunisia #1	Mainz, Germany	23,6	2.160
	Algeria #1	Hannover, Germany	24,1	2.851
	Algeria #2	Munich, Germany	24,9	1.998
France	Morocco #1	Paris, France	18,7	2.306
	Morocco #2	Paris, France	19,8	1.939
	Tunisia #1	Paris, France	21,3	2.195
	Algeria #1	Lion, France	25,3	1.847
	Algeria #2	Lion, France	24,6	2.208
United Kingdom	Morocco #1	London, UK	18,5	2.643
	Morocco #2	London, UK	22,4	2.304
	Algeria #1	Newcastle, UK	24,3	2.748
Spain	Morocco #2	Madrid, Spain	20,7	964
	Algeria #1	Zaragoza, Spain	24,2	1.178
Italy	Algeria #2	Milano, Italy	20,1	1.587
	Tunisia #1	Firence, Italy	19,3	1.432
	Libya #1	Roma, Italy	20,6	1.761
Poland	Egypt #1	Warszaw	18,9	3.525
	Jordan #1	Warszaw	18,1	3.500
	Egypt #2	Warszaw	22,1	3.817
	Saudi Arabia #1	Warszaw	23,8	3.586
Turkey	Jordan #1	Ankara, Turkey	19,3	2.255
	Saudi Arabia #1	Ankara, Turkey	20,0	2.310
	Saudi Arabia #1	Ankara, Turkey	20,6	2.310
Czech Republic	Algeria #2	Prague, Czech Republic	19,5	2.230
	Libya #1	Prague, Czech Republic	19,0	2.154
Belgium Netherlands	Morocco #1	Brussels, Belgium	19,0	2.612
	Morocco #2	Appledorn, Netherlands	22,1	2.462
Romania	Jordan #1	Bukarest, Romania	15,8	2.502
	Algeria #2	Bukarest, Romania	18,8	2.918
Greece / Bulgaria	Egypt #2	Sophia, Bulgaria	21,5	2.849
Hungary / Slowakia	Libya #1	Budapest, Hungary	24,7	2.254

Flexible solar power import to Germany starting 2022 with 12 ct/kWh (5% WACC, 40 a)

Source: Trieb et al., Energy Policy 42 (2012) 341-353

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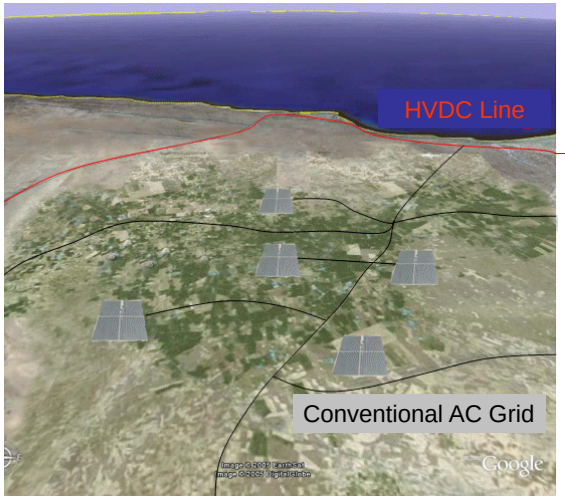
Role of CSP: firm capacity for power, desalination & export

Business case NA
energy, water, food, labor and income for a growing population in desert regions



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Business case EU
flexible renewable energy for Europe

BETTER focal points for large RES-E shares in EU and NA (preliminary):

1. **Limit RES-E variability:**
   1. tap flexible RES-E to provide firm capacity and other grid management functions
   2. develop and secure all available flexibility and backup options

2. **Limit RES-E cost by increasing investment security:**
   1. establish national RES-E administrations and adequate RES-E tariffs
   2. provide internationally insured power purchase agreements and further risk mitigation measures specifically adapted to the RES-E sources to be tapped

3. **Limit RES-E impacts:**
   1. ensure public participation through consultation and cooperative banks
   2. enforce thorough environmental and socio-economic impact assessment

4. **Establish reliable political framework:**
   1. pursue consensus within Europe and Third Countries about future RES-E role
   2. establish transparent, stable, fair and predictable framework for RES-E

Thank you for your attention!

Contact:

Tobias Fichter (tobias.fichter@dlr.de)

Natalia Caldes (natalia.caldes@ciemat.es)

Franz Trieb (franz.trieb@dlr.de)